

Perforated camouflage material

The invention relates to perforated camouflage material in the form of a camouflage-coloured sheet in which holes are made.

In this connection, the sheet represents a tarpaulin-like product, preferably manufactured in the form of a web, and intended for coverage for the purpose of masking military equipment and the like. The products in question may have built-in weaves, but carrier layers of non-woven type or plastics webs of other kinds may also be envisaged.

In the prior art there are already camouflage materials with a masking effect obtained by a pattern of holes where the holes appear as black grid points, whereby different half-tone patterns and "shadow effects" are obtained which give good optical camouflaging effect. Such materials are described, for example, in our Swedish patent 7505180-5.

For the purpose of providing a camouflage intended to camouflage warm objects against infrared reconnaissance, a camouflage with patterned perforation of this type cannot be used. As a matter of fact, a hot engine or the like, covered by such material, will emit heat radiation through the holes. The coverage will be insufficient.

Infrared reconnaissance is performed with the aid of apparatus (detector matrices, scanning detectors and the like) having good sensitivity within any one of the wavelength bands 3-5 μm and 8-14 μm . In such reconnaissance, hot and cold parts are detected and a heat image is obtained. Dead nature already gives a pattern of warm and colder surfaces, and a thermal camouflage material should therefore present warm as well as cold surfaces.

One object of the invention is to achieve a varied temperature image with a camouflage-coloured sheet masking an object which is warm in relation to the surrounding average temperature. Another object is to achieve transparency in such a sheet so as to enable an observer

(B) inside the masking to observe the surroundings without being seen.

5 According to the invention, perforated camouflage material in the form of a camouflage-coloured sheet in which holes are made, is characterized in that the sheet comprises a strengthening layer and, laminated thereon, a layer of a plastics material having tensional stresses, said holes consisting of
10 unconnected, curved slits going through the sheet, the slits forming tongues which, due to the action of the tensional stresses in said plastics material, are curved outwards from the plane of the sheet towards the side facing away from the strengthening layer on which said plastics material is applied.

15 A suitable plastics material having internal stresses is polyethylene film (e.g. LDPE, from which films are manufactured by blowing into thin tubes). During lamination under heat with a strengthening layer, e.g. a weave, the inner stresses in the film
20 will be released and the film will tend to shrink, but cannot. When the unconnected slits are then cut, the shrinkage stresses thus formed in the tongues will be released making the tongues curve outwards, and this can even go so far that a part of the
25 underside becomes visible in the forward direction of the sheet, which can give small patches of deviating colours.

It is suitable to distribute such holes in zones, so that zones with holes and zones without holes are
30 alternately obtained. If a warm object is to the interior of such a sheet, a ventilation will occur which in itself is advantageous and which warms the sheet at the zones, and should there be any wind, the draught through the holes will cause heat transfer to
35 these zones, while the temperature equilibrium in other zones is more determined by the radiation conditions of the surroundings.

The plastics layer may to advantage be provided with a thin layer of metal on the side facing inwards, which results in a certain amount of thermal reflection. It is also suitable to give the plastics layer a mat-treated surface, as it may otherwise be so glossy that the degree

of specular reflection is thus high enough to be observable, giving an effect clearly distinguishing from the surrounding nature.

The tarpaulin-like sheet obtained can be used as a covering and masking sheet per se and can have various painted or printed patterns which are no part of the present invention, however.

A material with a high degree of coverage is obtained with the aid of the invention, and the perforated portions should preferably have a coverage degree of about 90%. The size of the perforations in normal "tarpaulin types" should not exceed about 15 mm, since the flaps obtained would otherwise be too sloppy and the inventive effect lost.

A particularly practical advantage of the invention is the absence of waste material. In normal hole punching there are obtained waste roundels of no value which are difficult to get rid of. In accordance with the invention the whole of the manufactured material is essentially used for the intended purpose.

The invention will now be described in more detail by means of a non-limiting embodiment. Fig. 1 illustrates a sheet suitable for the application of the invention. Fig. 2 illustrates an example of a zone with cut hole slits. Fig. 3A schematically illustrates a punch for stamping webs, Figs. 3B and 3C illustrate a suitable hollow punch. Fig. 4A illustrates a hole seen from above. Fig. 4B illustrates the same hole in cross section. Fig. 5 schematically illustrates a lamination process. Fig. 6 illustrates an example of a perforation pattern.

Fig. 1 illustrates a sheet of the kind suitable for applying the invention. A layer 1 of blown LDPE containing green camouflage pigment is matted on one side 2, and the other, opposite side is provided with a vaporized thin metal deposit 3. The plastics layer is 40 μ m (for clarity reasons the figure is not in scale). This plastics layer is heat-laminated with a fusible adhesion film 4 of 30 g/m² (XIRO type 240) against a weave of solid-drawn multifilament polyamide 5 (16/16 threads/cm, with a weave of 235 dtex).

Fig. 2 illustrates the disposition of perforating slits 6 consisting of incomplete circles, and it will be seen that the missing portion of the circles points in different directions making the tongues thus formed pointing in different directions.

Fig. 3A illustrates a stamping apparatus 7 with a set of hollow punches 8. The stamping apparatus can be given reciprocating motion towards a table or a die 10. The die can be made to have depressed portions, so that the punches meeting the depressed portions do not operate against the web 9 laid over the die, which web can be of the type illustrated in Fig. 1. The punches 8, shown more closely in Fig. 3B, in cross section, and in Fig. 3C, from the cutting end, have ground-off edge portions 11.

Due to the stresses in the plastics layer, the incomplete circular perforations will curve upwards, as shown in Figs. 4A and 4B.

Fig. 5 schematically illustrates a suitable manufacturing procedure for the web shown in Fig. 1. The web 1 with its metallized layer is pulled from a roller not shown, the adhesive layer 4 from another roller not shown, and the weave 5 from a third storage roller not shown. The web 1 initially has a glossy surface. In one or more heated roll nips a structural pattern sheet 12 is rolled under pressure and heat against the collected webs. The structural pattern sheet can be a viscose weave enamelled with an enamel-containing matting agent to give it a matted surface, which will be depicted or embossed as a surface structure during the laminating operation.

Since the polyethene layer has been manufactured under tension (the normal, known manufacturing process occurs by blowing to a thin tube which is slit up), there is latent tension in the material which is released at the heating process during lamination and gives a shrinkage effect.

A condition for the invention to function is that the material cut with "incomplete holes" includes a first layer

of weave, for example, and a second layer in which a stress is built up so that this layer tends to shrink, but cannot do so before the perforations are made. Although this is preferably achieved by the described heat-lamination of a material with latent stresses, it will be appreciated that even a material in stretched condition can be applied to achieve the material thus pretensioned.

An example of a perforation disposition is illustrated in Fig. 6. For the sake of clarity the holes are shown as black patches, although in reality they will naturally correspond more to the shape illustrated in Fig. 4A. What is illustrated in Fig. 6 is a repeat length for a web having a width of 1 m. The repeat length is 4.5 m. It should be observed that in this case holes have been made in different zones, and that outside the zones the sheet is free from holes. It will also be seen that holes in two different sizes are present in the pattern, the richness of variation thus being improved. In actual fact, the holes are substantially smaller and more densely disposed. Their diameter is preferably about 15 mm.

The ~~inertive~~ holes provide good coverage against observation in spite of the holes giving a good ventilation effect in an oblique direction, since the gaps are very effective.



CLAIMS

1. Perforated camouflage material in the form of a camouflage-coloured sheet in which holes are made, characterized in that the sheet comprises a strengthening layer and, laminated thereon, a layer of a plastics material
5 having tensional stresses, said holes consisting of unconnected, curved slits going through the sheet, the slits forming tongues which, due to the action of the tensional stresses in said plastics material, are curved outwards from the plane of the sheet towards the side facing away
10 from the strengthening layer on which said plastics material is applied.

2. Perforated camouflage material as claimed in Claim 1, characterized in that the strengthening layer is a woven product.

15 3. Perforated camouflage material as claimed in Claim 1 or 2, characterized in that the adhered layer is a polyethylene film in which latent tension stresses are released during lamination under heat.

20 4. Perforated camouflage material as claimed in any one of the preceding claims, characterized in that the slits are circular arcs with an angle exceeding 180° and falling below 270° .

25 5. Perforated camouflage material as claimed in any one of the preceding claims, characterized in that the holes are made in zones where they are disposed according to a regular dot pattern, the material outside the zones being free from holes.

30 6. Perforated camouflage material as claimed in Claim 5, characterized in that holes of different sizes are made in different zones.

7. Perforated camouflage material substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
